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# Wildlife and Fisheries Habitat Management Notes

## Habitat Management for Forest Birds in Southeast Alaska

Winifred B. Sidle

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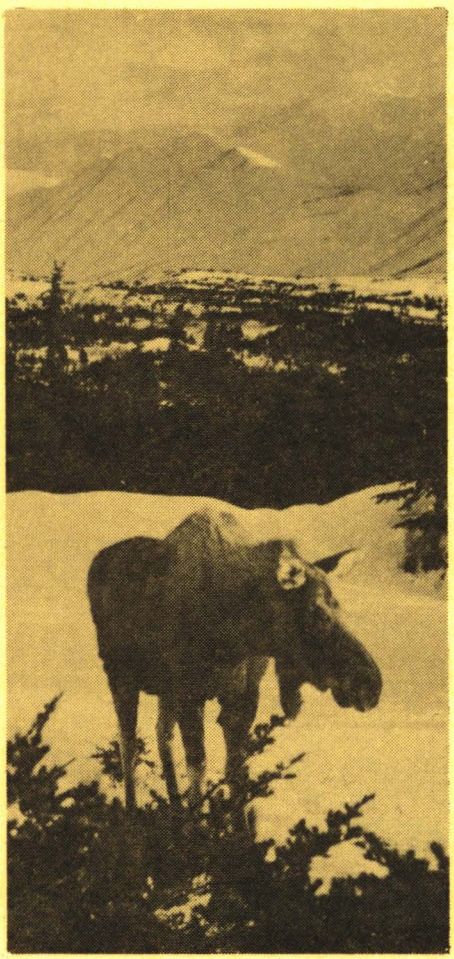

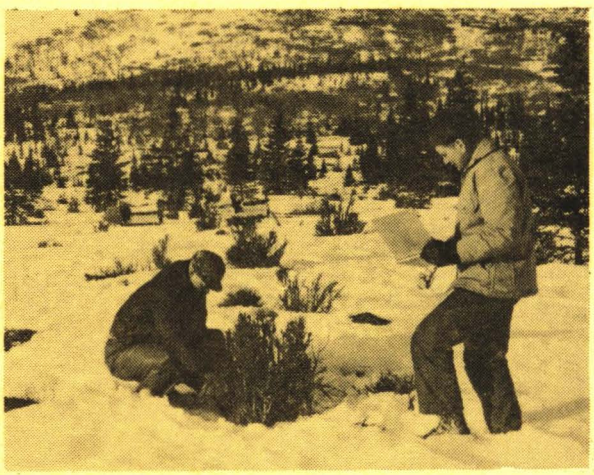

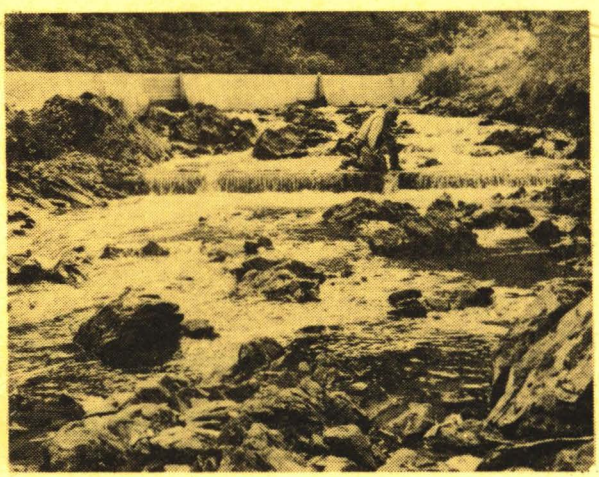

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# Habitat Management for Forest Birds in Southeast Alaska

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August 1985

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Charly Price

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# Forest Planning and Bird Habitat Management

Forest bird species, individually and in the context of avian communities, are affected when management activities bring about changes in the forest environment. Provisions of the National Forest Management Act (NFMA) provide direction for the consideration of birds in management of National Forest lands.

## Management for Diversity and Population Viability

Regulations implementing NFMA (36 CFR 219) require that the Forest Service plan for a diversity of plant and animal communities to meet multiple-use objectives. Diversity is a condition that results from the variety of species that occur in an area and from the distribution of habitats that support them. Diversity may be described at different levels of resolution (Whittaker 1972) that have significance in forest planning.

The alpha level pertains to diversity within specific habitats or limited land areas as measured by number of species present (species richness) alone or in combination with a measure of the relative abundance or importance (equitability) of species. The species richness of birds within a forest stand or successional stage is an example of alpha diversity. Beta diversity reflects the amount of species turnover between habitat types or along environmental gradients. An application in forest management would be the tracking of differences in bird species composition among stands of different successional stages. Gamma diversity reflects the total species richness over all habitats within a fairly large geographic area, such as a National Forest. Gamma diversity is a function of the spatial distributions of habitat. An area supports greater diversity of wildlife when species and groups are well distributed spatially.

Applications of diversity concepts to forest management have emphasized alpha diversity and, to a large extent, have ignored beta and gamma diversity (Faaborg 1980, Samson and Knopf 1982). In contrast, NFMA planning regulations emphasize beta and gamma diversity by defining diversity as "the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan (36 CFR 219.3). These regulations call for management prescriptions to maintain diverse distributions of species, communities, and habitats in space and time.

Ecologists recognize that diversity is a product of complex habitat conditions that may not be meaningfully expressed by any single numerical rating or index. Diversity levels for birds and other wildlife are not established as goals under the NFMA planning regulations. Rather, population viability is an established minimum threshold level that ensures the maintenance of diversity over the Forest: "Fish and Wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area" (36 CFR 219.19). The definition of minimum viable populations emphasizes the importance of animal and habitat distribution over the forest: "For planning purposes a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area". Management for forest birds must consider all bird species, their population levels, and the distributions of the species and their habitats over the Forest.

## Management Information Needs

The diversity and population viability provisions of NFMA provide direction for the management of bird habitat in the Alaska Region. Management strictly for diversity would emphasize the total numbers and distributions of species without qualifying species by ecological role, native versus non-native status, sensitivity to habitat change, or other characteristics that may define a "desirable" mix of species to manage for. Managers are required to consider more than just the total number of bird species present on the Forest. They must manage to ensure that no member of the existing native fauna is lost or replaced as a consequence of management activities.

These requirements place certain demands for knowledge on those responsible for managing forest bird habitat on lands administered by the Alaska Region. Managers need to know:

1. Which bird species occur in the planning area, and in which habitats?

2. What are the relationships of bird species to habitat features of Southeast Alaska forests?

3. How do forest management practices affect these habitat features and, subsequently, bring about changes in population levels, distributions, and diversity of bird species?

4. What forest management practices are appropriate for manipulating habitat for diversity objectives?

5. What species or groups of birds require special attention in management, and how can their habitats be maintained or enhanced through management?

The objective of this paper is to provide this knowledge to the extent possible. Only limited information is available on the distributions, population densities, and habitat relationships of forest birds in Southeast Alaska. This chapter was synthesized from the literature on avian habitat relationships, field studies of Southeast Alaska birds, and the Wildlife Habitat Relationships (WHR) data base for the USDA Forest Service Alaska Region.

## Sources of Information

The literature reports few field studies on the birds in coastal forests of western hemlock *(Tsuga heterophylla)* and Sitka spruce *(Picea sitchensis).* The earliest accounts of birds in Southeast Alaska were published by Grinnel (1909). Webster (1941, 1950, and 1978) has published notes on birds in selected locations within Southeast Alaska. Broad surveys of bird occurrence and distribution are reported in Gibson (1976) and Gibson and MacDonald (1975). The breeding bird communities of the coastal forest on northern Vancouver Island were described by Buckner et al. (1975).

The Forest Service has supported bird surveys for use in management of the Tongass National Forest (Kessler 1980, Kessler and Kogut 1985, Noble 1977). Bird observations along 78 transects in successional and old growth forest were recorded during the 1978 and 1979 breeding seasons on Kosciusko and Prince of Wales Islands (Kessler and Kogut 1985). Mean numbers of birds observed per 1,000-ft transect were used to assign abundance classes as rare (less than 0.50), uncommon (0.51-1.00), common (1.01-5.00), very common (5.01-10.00), abundant (10.01-15.00), and very abundant (greater than 15.00). A total of 3,780 bird observations included 35 species (Tables 1 and 2).

Species richness for the various habitat categories ranged from 7 to 27. Over half of all observations were of the five most abundant species: the winter wren[1], dark-eyed junco, golden-crowned kinglet, chestnut-backed chickadee, and orange-crowned warbler. The winter wren occurred in all successional stages and forest types. Nighttime surveys were conducted on these islands in the summer of 1979. Recorded calls were broadcast at 0.5 mile intervals along the road system to detect the presence of owl species (Kessler 1980). Responses were elicited from the northern pygmy, great horned, northern saw-whet, and western screech owls. Northern hawk-owls were observed in open habitats such as muskegs and clearcuts during the daytime.

footnote

[1]Scientific names of bird species are provided in the appendix.

**Table 1.** Species and abundance class[1] of birds observed during the breeding season in successional stages of the closed western hemlock-Sitka spruce forest type[2] of Southeast Alaska. (Source: Kessler and Kogut 1985).

| | NONRIPARIAN HABITATS | | | | | RIBARIAN HABITATS | | |
|---|---|---|---|---|---|---|---|---|
| SPECIES | SHRUB/ FORB | SAPLING/ SHRUB | POLE | YOUNG SAWTIMBER | OLD GROWTH | SAPLING/ SHRUB (Stream) | OLD GROWTH (Stream) | OLD GROWTH (Saltwater Inlet) |
| Common merganser | | | | | | R | R | |
| Bald eagle | | | | | | • | | • |
| Sharp-shinned hawk | | | | | R | | | |
| Red-tailed hawk | | | | | | R | | |
| Spotted sandpiper | | | | | | • | | |
| Rufous hummingbird | | | | | | •• | R | •• |
| Belted kingfisher | | | | | | • | R | R |
| Red-breasted sapsucker | | | | | R | •• | • | •• |
| Hairy woodpecker | R | | | | | • | | •• |
| Western flycatcher | | | •• | •• | •• | • | •••• | ••• |
| Tree swallow | •• | •• | | | | ••••• | | |
| Steller's jay | • | •• | •• | | | • | •• | • |
| Northwestern crow | | | | | | | | •• |
| Common raven | R | | | | R | | R | |
| Chestnut-backed chickadee | | •• | ••• | ••• | ••• | •• | •• | ••• |
| Brown creeper | | | | | | | | • |
| Winter wren | ••••• | ••• | ••• | ••• | ••• | •••• | ••• | •• |
| American dipper | | | | | | • | | |
| Golden-crowned kinglet | | R | •• | •••• | ••• | | ••• | ••• |
| Ruby-crowned kinglet | | | •• | | | R | | |
| Swainson's thrush | | R | •• | | | •• | •• | •• |
| Hermit thrush | • | •• | •• | •• | •• | • | •• | •• |
| American robin | R | | •• | | | • | | |
| Varied thrush | | • | •• | • | •• | R | •• | •• |
| Orange-crowned warbler | R | •• | • | | •• | •••• | • | •• |
| Yellow warbler | | | | | | R | | |
| Townsend's warbler | | | • | •• | ••• | R | •• | •• |
| Wilson's warbler | | | | | R | R | R | |
| Fox sparrow | R | ••• | ••• | | | | | |
| Song sparrow | | • | | | | •• | | R |
| Lincoln's sparrow | | | | | | •• | | •• |
| Pine siskin | | | | | | • | ••• | •• |
| Dark-eyed junco | ••• | ••• | • | | •• | ••••• | •• | • |
| Species Richness | 10 | 12 | 14 | 7 | 13 | 27 | 18 | 21 |

[1]Abundance classes are rare (R), uncommon (•), common (••), very common (•••), abundant (••••), and very abundant (•••••).
[2]Forest types follow Viereck and Dyrness (1980).

**Table 2.** Species and abundance class[1] of birds observed during the breeding season in riparian old growth habitat within the closed western hemlock-redcedar and open shore pine-western hemlock forest types[2]. (Source: Kessler and Kogut 1985).

| SPECIES | FOREST TYPE | |
|---|---|---|
| | HEMLOCK-CEDAR (Lake) | PINE-HEMLOCK (Muskeg) |
| Bald eagle | | R |
| Greater yellowlegs | | • |
| Northern hawk-owl | | R |
| Rufous hummingbird | R | R |
| Belted kingfisher | R | |
| Red-breasted sapsucker | •• | • |
| Hairy woodpecker | R | R |
| Western flycatcher | •• | •• |
| Tree swallow | | • |
| Steller's jay | • | •• |
| Chestnut-backed chickadee | •• | ••• |
| Winter wren | • | •• |
| Golden-crowned kinglet | ••• | • |
| Ruby-crowned kinglet | | R |
| Swainson's thrush | | • |
| Hermit thrush | • | •• |
| American robin | R | •• |
| Varied thrush | •• | • |
| Orange-crowned warbler | •• | •• |
| Townsend's warbler | •• | • |
| Wilson's warbler | R | |
| Lincoln's sparrow | •• | •• |
| Dark-eyed junco | ••• | •••• |
| Pine siskin | •• | •• |
| Species Richness | 18 | 22 |

[1]Abundance classes are rare (R), uncommon (•), common (••), very common (•••), abundant (••••), and very abundant (•••••).
[2]Forest types follow Viereck and Dyrness (1980).

# Forest Birds of Southeast Alaska

### Sources of information (continued)

The Alaska Department of Fish and Game conducted studies on Admiralty Island in 1982 and 1983 to determine habitat relationships of wintering birds to old growth stands of Sitka spruce and western hemlock (J. Hughes, Alaska Department of Fish and Game, Anchorage, manuscript in preparation). Species richness of wintering birds ranged from 10 in low volume (less than 20,000 bd ft/ac) to 16 in higher volume (greater than 25,000 bd ft/ac) stands (Table 3).

Habitat information for the USDA Forest Service Wildlife Habitat Relationships data base (Alaska Region, Juneau) was compiled from literature searches for species known to occur in Southeast Alaska (Hanley and Taber 1978). The list includes 113 species of birds that use forest habitat for reproduction and/or feeding. Species orientations to forest successional stages used for reproduction and feeding were described by three importance classes (Table 4). A successional stage of most important status (1) is used the majority (greater than 51%) of the time, or is obviously selected for when available, or is used in much higher proportion than its occurrence. A habitat of moderate importance (2) is used less than half the time, or is apparently selected for when available, or is used approximately in proportion to its occurrence. A habitat of least importance (3) is used as a last resort in absence of a preferred situation, or is used in much lower proportion than its occurrence (USDA Forest Service 1984).

**Table 3.** Species and abundance class[1] of winter resident birds observed in three volume classes of old growth Sitka spruce-western hemlock in Southeast Alaska. (Source: J. Hughes, Alaska Department of Fish and Game, Anchorage, manuscript in preparation).

| | VOL. CLASS (thousands of bd ft) | | |
|---|---|---|---|
| SPECIES | Less Than 20 | 20-40 | More Than 40 |
| Bald eagle | | R | R |
| Blue grouse | | ••• | ••• |
| Northern pygmy owl | | R | R |
| Hairy woodpecker | • | • | • |
| Three-toed woodpecker | | R | R |
| Steller's jay | • | • | • |
| Common raven | ••• | ••• | ••• |
| Chestnut-backed chickadee | ••• | ••• | ••• |
| Brown creeper | R | • | •• |
| Winter wren | | • | • |
| Varied thrush | | R | R |
| Golden-crowned kinglet | ••• | ••• | ••• |
| Dark-eyed junco | R | R | R |
| Red crossbill | ••• | ••• | ••• |
| White-winged crossbill | •• | •• | •• |
| Pine siskin | ••• | ••• | ••• |

[1]Abundance classes are rare (R), uncommon (•), fairly common (••), and common (•••) following Isleib and Kessel (1973).

**Table 4.** Forest successional stages that are most important (1), moderately important (2), or least important (3) to Southeast Alaska birds for reproduction (R) and feeding (F). Successional stages are unstocked clearcuts (U), sapling/shrub (SS), poles (P), young second-growth sawtimber (YG), and old growth (OG). (Source: Wildlife Habitat Relationships data base for the Alaska Region. USDA Forest Service, Juneau, AK).

| | SUCCESSIONAL STAGE | | | | |
|---|---|---|---|---|---|
| SPECIES | U | SS | P | YG | OG |
| Vancouver canada goose | | | | | 1R, 2F |
| Green-winged teal | | 2R | | | 2R |
| Mallard | 3R | 3R | 3R | 3R | 3R |
| American wigeon | 3R | 3R | 3R | 3R | 3R |
| Harlequin duck | | 2R | 2R | 2R | 2R |
| Common goldeneye | | | 3R | 3R | 1R |
| Barrow's goldeneye | | | 3R | 3R | 1R |
| Bufflehead | | | 3R | 3R | 1R |
| Common merganser | 3R | 3R | 3R | 3R | 1R |
| Red-breasted merganser | 3R | 3R | 3R | 3R | 1R |
| Osprey | | | | | 2R |
| Bald eagle | 3F | | | 3F | 1R, 1F |
| Northern harrier | 2F | | | | |
| Sharp-shinned hawk | 2F | 2F | 1R, 2F | 2F | 2R, 2F |
| Northern goshawk | 1F | 2F | 3R, 3F | 2F | 1R, 2F |
| Swainson's hawk | 3F | | | | |
| Red-tailed hawk | 1F | 1F | | 3R | 1R |
| Rough-legged hawk | 2F | 2F | | | |
| Golden eagle | 2F | 2F | | | |
| American kestrel | 1F | 3F | 3F | 3R, 3F | 1R, 3F |
| Merlin | 2F | 2F | | 3R | 1R |
| American peregrine falcon | 3F | 3F | | | |
| Peale's peregrine falcon | 3F | 3F | | | |
| Gyrfalcon | 2F | | | | |
| Spruce grouse | | 2F | 2F | 3R, 2F | 1R, 1F |
| Blue grouse | 2F | 3R, 1F | 3R | 3R, 3F | 1R, 1F |
| Willow ptarmigan | 3F | 2R, 2F | | | 3R, 2F |
| Rock ptarmigan | 2F | 2F | | | |
| White-tailed ptarmigan | 3F | 2F | | | |
| Ruffed grouse | 3F | 3R, 3F | | | |
| Bonaparte's gull | | | | 3R, 3F | 3R, 3F |
| Ancient murrelet | | | | | 2R |
| Band-tailed pigeon | | 2F | | | 3R, 3F |

**Table 4, continued.** Forest successional stages that are most important (1), moderately important (2), or least important (3) to Southeast Alaska birds for reproduction (R) and feeding (F). Successional stages are unstocked clearcuts (U), sapling/shrub (SS), poles (P), young second-growth sawtimber (YG), and old growth (OG). (Source: Wildlife Habitat Relationships data base for the Alaska Region. USDA Forest Service, Juneau, AK).

| | SUCCESSIONAL STAGE | | | | |
|---|---|---|---|---|---|
| SPECIES | U | SS | P | YG | OG |
| Mourning dove | 3F | 3R, 3F | 3R | 3R | 3R |
| Western screech owl | | | | 3R, 3F | 1R, 1F |
| Great horned owl | 2F | 2F | 3F | 2R, 2F | 1R, 1F |
| Northern hawk-owl | 2F | 2F | | 3R | 1R |
| Northern pygmy owl | | 2F | 1F | 2R, 2F | 1R, 2F |
| Great gray owl | 1F | 3F | | 3R | 1R |
| Short-eared owl | 3F | | | | |
| Boreal owl | 2F | 2F | | 3R, 3F | 1R, 2F |
| Northern saw-whet owl | 2F | 3F | | 2R, 3F | 1R, 1F |
| Vaux's swift | 2F | 2F | | 3R | 1R |
| Rufous hummingbird | 2F | 2R, 1F | 2R | | |
| Red-breasted sapsucker | | | 3R | 3R, 3F | 1R, 1F |
| Downy woodpecker | | 2F | 3F | 2R, 3F | 1R, 1F |
| Hairy woodpecker | | 3R, 2F | 3F | 3F | 1R, 1F |
| Three-toed woodpecker | | | | 3F | 1R, 1F |
| Black-backed woodpecker | | | | 3F | 1R, 1F |
| Northern flicker | | | 3R, 3F | 3R, 3F | 1R, 2F |
| Olive-sided flycatcher | 2F | 2F | 3R, 3F | 3R, 3F | 2R, 3F |
| Western wood-pewee | | 3F | | | 3F |
| Alder flycatcher | | 3R | | | |
| Hammond's flycatcher | | | 2F | 3R, 2F | 1R, 2F |
| Western flycatcher | | 2R, 2F | 2R, 2F | 2R, 2F | 1R, 2F |
| Say's phoebe | 2F | 2F | | | |
| Tree swallow | 2R, 2F | 2R, 2F | | 3R | 2R |
| Violet-green swallow | 2F | 3F | | 3R | 3R, 3F |
| Northern rough-winged swallow | 3F | 3F | | | |
| Bank swallow | 3F | 3F | | | |
| Barn swallow | 3F | 3F | | | |
| Gray jay | | 2F | 3F | 3R | 2R, 2F |
| Steller's jay | 3R, 3F | 2R, 2F | 2R, 2F | 3R, 3F | 2R, 2F |
| Black-billed magpie | | 2F | | | |
| Northwestern crow | | 3F | 3F | 3R, 3F | 2R, 2F |
| Common raven | 3F | 2F | | 3F | 1R, 2F |

**Table 4, continued.** Forest successional stages that are most important (1), moderately important (2), or least important (3) to Southeast Alaska birds for reproduction (R) and feeding (F). Successional stages are unstocked clearcuts (U), sapling/shrub (SS), poles (P), young second-growth sawtimber (YG), and old growth (OG). (Source: Wildlife Habitat Relationships data base for the Alaska Region. USDA Forest Service, Juneau, AK).

| | SUCCESSIONAL STAGE | | | | |
|---|---|---|---|---|---|
| SPECIES | U | SS | P | YG | OG |
| Black-capped chickadee | 3R | 3R, 3F | 3F | 3F | 2R, 2F |
| Boreal chickadee | | 3R, 3F | 3F | 3F | 1R, 1F |
| Chestnut-backed chickadee | 3R | 2R, 2F | 3R, 2F | 2R, 2F | 1R, 1F |
| Red-breasted nuthatch | | | | 3R, 2F | 1R, 1F |
| Brown creeper | | | | 3F | 1R, 1F |
| Winter wren | 1R | 1R, 1F | 2R, 3F | 2R, 2F | 1R, 2F |
| Golden-crowned kinglet | | | 3R, 3F | 2R, 2F | 1R, 1F |
| Ruby-crowned kinglet | | 2R, 2F | 2R, 3F | 3R, 3F | 3R, 3F |
| Mountain bluebird | 3F | 3F | | | 3F |
| Townsend's solitaire | 3F | 3R, 3F | | | 3R, 3F |
| Gray-cheeked thrush | | 2R, 2F | | | |
| Swainson's thrush | 3F | 1R, 1F | 2R, 2F | | 3R, 3F |
| Hermit thrush | 3F | 2R, 2F | 2R, 3F | 2R, 3F | 2R, 2F |
| American robin | 2F | 1R, 1F | 2R, 2F | | |
| Varied thrush | | 2R, 2F | 3R, 3F | 2R, 3F | 1R, 2F |
| Bohemian waxwing | 3F | 1F | | | |
| Cedar waxwing | 2F | 2R, 2F | | | 3R, 3F |
| Northern shrike | 2F | 3R, 2F | 3F | 3F | 3F |
| Orange-crowned warbler | 3R, 2F | 1R, 1F | | | 2R, 2F |
| Yellow warbler | | 2R, 2F | | | 2R, 2F |
| Yellow-rumped warbler | | 3R, 3F | 3R | 3R | 1R, 1F |
| Townsend's warbler | | 2R, 2F | 3R, 3F | 3R, 3F | 2R, 1F |
| Blackpoll warbler | | 2R, 2F | 2R, 3F | 3R, 3F | 2R, 3F |
| Northern waterthrush | 3R, 3F | 3R, 3F | 3R, 3F | 3R, 3F | 3R, 3F |
| MacGillivray's warbler | 2R, 2F | 1R, 1F | | | 3R, 3F |
| Wilson's warbler | 3R, 2F | 2R, 1F | | | 2R, 2F |
| Western tanager | 3F | 2F | 3R | 3R | 2R, 2F |
| Brewer's blackbird | 3F | 3R, 3F | | | 3R, 3F |
| Common grackle | | | | 3F | 3F |
| Rosy finch | 3F | | | | |
| American tree sparrow | 3F | 3F | | | |
| Chipping sparrow | | 2R, 2F | | | |
| Fox sparrow | 3F | 1R, 1F | 3R, 3F | | |

**Table 4, continued.** Forest successional stages that are most important (1), moderately important (2), or least important (3) to Southeast Alaska birds for reproduction (R) and feeding (F). Successional stages are unstocked clearcuts (U), sapling/shrub (SS), poles (P), young second-growth sawtimber (YG), and old growth (OG). (Source: Wildlife Habitat Relationships data base for the Alaska Region. USDA Forest Service, Juneau, AK).

| | SUCCESSIONAL STAGE | | | | |
|---|---|---|---|---|---|
| SPECIES | U | SS | P | YG | OG |
| Song sparrow | 3R, 3F | 2R, 2F | | | |
| Lincoln's sparrow | | 2R, 2F | | | 2R |
| White-throated sparrow | | 3F | | 3F | 3F |
| Golden-crowned sparrow | 3F | 2F | | | |
| White-crowned sparrow | 3F | 2F | | | |
| Harris' sparrow | | 3F | | 3F | 3F |
| Dark-eyed junco | 2R, 2F | 1R, 1F | 2R, 3F | | 2R, 2F |
| Pine grosbeak | 3F | 2F | 3R, 3F | 2R, 3F | 2R, 2F |
| Purple finch | 3F | 3F | 3F | 3F | |
| Red crossbill | | | 3F | 3R, 3F | 1R, 1F |
| White-winged crossbill | | | 3F | 3R, 2F | 1R, 1F |
| Common redpoll | 3F | 2F | | | 3F |
| Pine siskin | | 3F | 3F | 3R, 2F | 1R, 1F |
| Evening grosbeak | | 3F | | 3F | 3F |

## Diversity Relationships

The field studies conducted in Southeast Alaska suggest that gamma diversity of birds in the coastal forest is generally low. The number of species observed is small when compared to coniferous forests in general and coastal forests of the northwest in particular (refer to Wiens 1975 for comparative data). The number of bird species detected during field surveys is low compared to the WHR data base listing of species that would be expected to occur on the basis of available forest habitat. Undoubtedly, the more secretive species were missed by the surveys. Surveys conducted thus far do not represent all habitats or seasons.

Diversity and distribution of forest birds in Southeast Alaska are likely to be influenced by the position of Southeast Alaska between the Pacific Ocean and the Coast Mountain Range. These geographic barriers may restrict the distribution of species that would be expected to find suitable habitat in Southeast Alaska. These barriers certainly influence the biogeographic geometry and isolation of Southeast Alaska—characteristics that determine, to a large extent, the diversity of species established on a land mass (Diamond and Gilpin 1983). A relatively low species richness on islands of Southeast Alaska may be explained by island biogeography theory. Within an island archipelago, the species richness encountered on individual islands is a dynamic equilibrium between immigration rates and extinction processes, and is a fraction of the species richness found in the mainland "source" area (MacArthur and Wilson 1967).

# Habitat Relationships of Forest Birds

## Stand Structure

The structure of a forest stand can vary in complexity in accordance with the number of overstory and understory layers present, and with the density, heights, diameters, ages, and health of trees within those layers (Hall 1980). The degree of structural complexity that results from the number and types of overstory and understory layers has been termed vertical profile, foliage height diversity, and simply "layers". Many studies have concluded that this feature is one of the strongest predictors of alpha diversity of birds in temperate forest stands (Balda 1975, MacArthur and MacArthur 1961, MacArthur et al. 1962). In general, the more complex the vertical structure of a stand, the more bird species may be supported.

Old growth stands of Southeast Alaska have a complex vertical structure. Old growth stands contain multiple layers and a wide range of tree heights and sizes (Alaback 1982). A well-developed layer of shrubs and herbs occurs in a patchy distribution beneath openings in the forest canopy.

The old growth forest of Southeast Alaska contains a high degree of structural complexity in the horizontal plane as well. Patches of successional vegetation occur in openings where older trees have fallen from disease, insects, or windthrow. In this respect, much of the forest exists as a "dynamic steady state" that contains plant species and structural components representative of the entire successional sequence.

## Forest Succession

The vertical and horizontal structure of Southeast Alaska old growth changes dramatically when stands are clearcut. For several years the cutover area contains only a ground covering of shrubs, herbaceous plants, tree seedlings, and slash. A second layer is added as saplings of western hemlock and Sitka spruce overtop the shrub layer, and this structure exists up to crown closure at around 15-25 years. Afterward, the understory is shaded out, and the stand changes to a single, even-age layer of spruce and hemlock. Deciduous shrubs and herbs do not begin to become established again until the stand is 140-160 years old (Alaback 1982).

Bird surveys conducted in successional and old growth stands in Southeast Alaska (Tables 1 and 2) suggest general relationships between alpha diversity and stand structural development during the successional sequence following clearcutting. The relatively high alpha diversity of birds in the old growth forest is reduced by clearcutting. Of species observed, only the winter wren and the dark-eyed junco were observed to nest in clearcuts in the shrub/forb stage. Species richness in the mid-successional stages (sapling/shrub and pole) is similar to that in old-growth. A decline in alpha diversity following canopy closure is indicated by the low numbers and uneven relative abundance of species observed in young sawtimber. Over half of total observations were of only two species, the golden-crowned kinglet and Townsend's warbler. Only seven species in all were recorded in this successional stage. Habitat was not available for species that require understory vegetation for nesting and/or feeding.

Without management, most second-growth stands will become single-layered following canopy closure, and will remain in this condition throughout the rotation (Alaback 1982). The implication to management of forest birds is that alpha diversity in closed second-growth stands will remain depressed for approximately 70 percent of the rotation under an assumed rotation of 100 years.

## Riparian Habitat, Edges, and Interspersion

In Southeast Alaska, abundant riparian habitat occurs in association with streams, lakes, muskegs, and saltwater bodies. Riparian habitats in the moist coastal forest do not provide as much contrast with surrounding habitat as is the case in drier forest types. These zones do, however, contain components of habitat diversity such as deciduous trees, access to water, and a lush growth of shrubs and herbaceous plants.

Data from Forest Service surveys suggest that riparian habitats in Southeast Alaska support relatively high levels of species richness (Table 1). For both clearcuts and old growth, greater numbers of species were observed in riparian habitats than in nonriparian situations of the same successional stage. A preference for riparian habitats was suggested for some species. The western flycatcher was most numerous in riparian situations within mature forest stands. Most observations of song sparrows occurred in riparian situations within sapling/shrub stage clearcuts. The Lincoln's sparrow and rufous hummingbird were associated with brushy riparian vegetation in both mature forest and clearcuts. The northwestern crow was associated with mature forest stands along saltwater inlets. Three cavity nesting species, the tree swallow, hairy woodpecker, and red-breasted sapsucker, were most abundant in riparian zones where snags were available.

# Habitat Relationships of Forest Birds

Edge is the general term applied to a change in habitat where plant communities or successional stages meet (Thomas 1979). Edges are often associated with increased richness of flora and fauna relative to surrounding habitats. Interspersion is the intermixing of plant communities and successional stages that provide habitat for animals in a defined area (Thomas 1979). Although forests dominate the landscape throughout the spruce-hemlock type, natural edge and interspersion patterns are provided by nonforest communities such as muskegs, alpine, and beach communities. Natural interspersion patterns and edge also result from windthrow, which creates patches of successional vegetation within the forest. Edge and interspersion are changed through timber harvest activities, and this may affect the distribution, composition, and diversity of bird species over the forest. For management purpose, bird species may be placed into two general groups on the basis of their relationships to edge and interspersion in the managed forest.

Increased edge and interspersion will enhance habitat capability for "edge" species that find optimal habitat along the boundaries of vegetation units. Often, edge wildlife are the more common and widespread species present in an area (Samson and Knopf 1982). Creation of edge along clearcut boundaries and interspersion of successional stages enhance habitat capability for bird species that use mature forest for one activity (such as nesting) and early successional stands for another activity (such as foraging). This differential use of clearcuts and adjacent forest stands may be observed in Southeast Alaska species such as the red-tailed hawk, northern hawk-owl, and tree swallow. Species that require more than one successional stage may be favored if the pattern, timing, and extent of clearcutting result in a high degree of interspersion of successional stages over the management area (Kelker 1964).

A different type of response occurs for birds that find optimal habitat within the interior of extensive forests. For these "area sensitive" birds, fragmentation of the forest into a mosaic of successional stands may result in population declines (Anderson and Robbins 1981, Lynch and Whitcomb 1978, Robbins 1979). Whitcomb et al. (1981) have identified biological characteristics that these species have in common. Most area sensitive species are long distance (neotropical) migrants, and are obligate inhabitants of the forest interior. Typically, they nest on or near the ground rather than in cavities, raise only a single brood per year, and have a relatively small clutch size. These species do best when forest habitat is left in large continuous blocks rather than interspersed with successional stands.

The effect of forest fragmentation on bird species diversity is an important management issue in the eastern deciduous forest where the area sensitive, neotropical migrants may comprise a majority of the breeding bird fauna (Lynch and Whitcomb 1978). In contrast, bird communities of mature forests in the Pacific Northwest may be dominated by permanent residents, and migrants may be best represented on cutover areas (Bowles 1963, Harris 1984). In the Northwest, concern for area sensitivity is often based on individual resident species of large home range size, such as spotted owls, pileated woodpeckers, and northern goshawks. Similarly, in Southeast Alaska, management will likely focus on species that are found to require relatively large blocks of old growth forest.

## Snags

Snags are important components of wildlife habitat in forest environments. The most important function for birds is provision of nest sites for cavity nesting species. Populations of cavity nesting birds may be limited by the availability of snags (Thomas et al. 1975).

Several categories of cavity nesters are recognized in management. Cavity dependent species require cavities for nesting, whereas other cavity users are able to use a variety of nest sites or structures. Primary excavators are able to construct their own cavities in snags or partially-dead trees. Primary excavators in the forests of Southeast Alaska include the red-breasted sapsucker, downy woodpecker, hairy woodpecker, three-toed woodpecker, black-backed woodpecker, northern flicker, and red-breasted nuthatch. Secondary cavity users must utilize existing natural cavities or those provided by the primary excavators. In Southeast Alaska, a variety of ducks, birds of prey, and passerines nest in available cavities or other protected sites on snags. Management often focuses on the primary excavators because their population levels determine the supply of cavities for the other cavity using species (Thomas et al. 1979).

Primary excavators are selective in their use of snags and partially-dead trees. Preference for snag size (diameter, height) and degree of soundness are exhibited among species. Certain features, such as softened heartwood and broken tops, are correlated with use (Conner et al. 1976, McClelland et al. 1979). Preferences for tree species are related to the decay properties and longevity of the snags.

Noble and Harrington (1981) surveyed the availability and use of snags in old growth forest stands on Prince of Wales Island. They found that 4.6 percent of all Sitka spruce examined contained cavities excavated by birds. Use rates of western hemlock and western redcedar *(Thuja plicata)* snags were 2.1 percent and 2.8 percent, respectively. No cavities were found in Alaska cedar *(Chamaecyparis nootkatensis)* and shore pine *(Pinus contorta).*

Snag management may be desirable where the availability of snags is a limiting factor of habitat. Under these conditions, a direct relationship is assumed between snag availability and population levels of cavity nesting birds (Thomas et al. 1979). Low snag use rates reported by Noble and Harrington (1981) suggest that snags are not limiting in the old growth forest of Southeast Alaska. Existing management practices severely reduce the supply of snags in the managed portion of the forest, however. Since the mid-1960s, snags have been removed from clearcut units in compliance with safety standards developed by the Occupational Safety and Health Administration. The habitat capability of second growth stands for cavity users remains low throughout the rotation. This reduces alpha diversity of birds in second-growth stands, and may affect the distribution of cavity nesting species over the forest.

## Old Growth

Old growth habitat is becoming scarce in many forest types throughout the United States. Some species of birds find optimal habitat in old growth, and undergo population declines when the forest is fragmented by development. Southeast Alaska is unique in having over 90 percent of its commercial forest land in old growth at present (USDA Forest Service 1979).

The extent to which bird species prefer or require old growth in Southeast Alaska is not well understood. Old growth is considered the most important breeding habitat for 41 bird species, and the most important feeding habitat for 21 species (Table 4). These habitat relationships are based on information from other geographic areas and, in many cases, from different forest types than those in Southeast Alaska. Existing field data are of limited use in validating these habitat relationships. Bird surveys conducted by the Forest Service (Kessler 1980, Kessler and Kogut 1985, Nobel 1977) were designed primarily for detection of passerines and other small-bodied, territorial species. They were not effective in detecting the larger species having extensive territories, such as goshawks and three-toed woodpeckers, that are generally associated with mature and old growth forest. Findings by J. Hughes (Alaska Department of Fish and Game, Anchorage, manuscript in preparation) suggest that old growth provides optimal habitat for several wintering species of birds.

# Silvicultural Options

The habitat features that influence bird distribution, abundance, and diversity are subject to modification by silvicultural treatments prescribed for management objectives. Habitat change occurs whenever a silvicultural treatment is applied to a stand of timber. Collectively, these treatments affect the amounts and interspersions of successional stages, and are a function of the silvicultural systems selected.

## Silvicultural Systems

The effects of timber harvest on avian species diversity, composition, distribution, and population level have been evaluated for a variety of silvicultural systems and coniferous forest types (Balda 1979, Franzreb 1977, Gottfried 1983, Hagar 1960, Meslow and Morrison 1983, Scott 1983, Szaro 1977, Webb et al. 1977, and others). These studies have identified general relationships between the magnitude of change in forest bird communities and the silvicultural systems used. The greater the alteration of stand structure, the greater is the magnitude of change in the bird community. Systems that leave the stand at least partially intact (e.g., sanitation cuts, strip shelterwood, group and individual tree selection) cause relatively minor change in the resident bird community. Systems that change stand structure dramatically (e.g., clearcutting, seed tree, heavy thinning) cause major changes in bird species diversity, composition, and/or abundance.

Clearcutting, the most common silvicultural system applied to stands of western hemlock and Sitka spruce, is recommended as the preferred system where timber production is the primary use (Ruth and Harris 1979). Clearcutting has been the exclusive method used to harvest timber on a commercial basis on Forest Service lands in Southeast Alaska. Other systems are suitable for hemlock-spruce stands, and have potential for use where timber production is not the dominant use. These alternatives include the seed tree, shelterwood, and selection systems (Ruth and Harris 1979).

The seed tree and shelterwood systems, like clearcutting, are designed to regenerate a new, even-age stand. They differ from clearcutting in that trees are left as a seed source (seed tree) and/or to provide shelter for the young seedlings (shelterwood). A large change in bird species composition is expected for all three systems, as species associated with mature forest are replaced by those associated with the earlier successional stages. Initially, alpha diversity may be greater under the seed tree and shelterwood systems because the standing trees provide a habitat feature not available in clearcuts. This feature is short-lived on a seed tree cut if the seed trees are removed after the new stand has become established. The utility of trees in shelterwoods is also limited if the trees are removed in subsequent cuttings to optimize growth of the new stand. The greatest potential advantages of these systems relative to clearcutting are found in snag management.

Selection systems require frequent entries to remove trees singly or in groups. This process maintains an uneven-age stand structure, and is preferable for certain wildlife management objectives. Bird species composition and diversity may not be significantly changed by timber harvest because the uneven-aged structure of the stand remains intact. Selection systems are appropriate where the wildlife objective is to favor bird species of mature or old growth habitats. These systems offer the greatest potential for snag management. Selection systems have disadvantages in timber management, however (Ruth and Harris 1979). Damage to the stand may occur with the frequent entries. Some old-growth stands are infected with dwarf mistletoe, or contain a large component of old residual trees that may die from exposure or wind damage. Logging would be more complex and costly under the selection system. Still, selective harvest may be an option to consider where uses other than timber production are emphasized. For example, selection systems may be applied to manage riparian zones and other selected old-growth habitats.

## Site Preparation

Site preparation consists of treatments applied to the harvested site to prepare for establishment of the new stand. Management of slash, or unmerchantable forest residues, is an important component of site preparation in many forest types. Slash treatment options used in western hemlock and Sitka spruce forests outside of Southeast Alaska include broadcast burning, piling and burning, yarding of unmerchantable material, and chipping (Ruth and Harris 1979). These treatments involve the reduction, removal, or rearrangement of woody debris, and affect food and cover conditions for wildlife.

Slash occurs in large volumes on Southeast Alaska clearcuts because the harvested old growth contains much defect, and decomposition occurs at relatively slow rates in the moist, cool climate (Ruth and Harris 1979). Logging slash is generally left untreated in Southeast Alaska, however. This is the most economical option, given that residues do not constitute a fire hazard in the moist environment. It is unlikely that management of logging slash would have

significant short-term effects on birds because few species find habitat in new clearcuts. Slash reduction would improve accessibility of stands for second-growth management activities, such as thinning, which may provide long-term benefits to birds and other wildlife.

Site preparation also includes treatments to control vegetation that competes with the new crop of conifers on cutover areas. In the hemlock-spruce forest, control of brush by mechanical treatments, prescribed burning, or herbicides may be recommended in problem areas within alluvial flats and valley bottoms. Although these treatments have potential to affect habitat conditions in riparian zones, they are not common practices in Southeast Alaska. Control of red alder *(Alnus rubra),* considered a serious competitor with conifers, may affect birds that have a habitat requirement for deciduous trees. Data are not available from Southeast Alaska to assess the importance of alder to birds. The bird communities of red alder forests have been studied in western Washington (Stiles 1980), and exhibit much overlap with bird species composition in old growth and successional stands of hemlock-spruce in riparian zones of Southeast Alaska.

## Regeneration

Natural regeneration is the dominant method for stocking clearcuts in Southeast Alaska. Other options, such as seeding and planting, are common in hemlock-spruce stands in Oregon and Washington (Ruth and Harris 1979). In Southeast Alaska, planting occurs only on selected areas where natural regeneration has produced inadequate stocking.

Natural restocking on clearcuts in Southeast Alaska usually produces an overstocked condition. Overstocking develops when advance regeneration, usually hemlock, is released by overstory removal. The consequences to bird habitat are early canopy closure, loss of understory vegetation, and reduction of structural diversity within the stand. Alternatives to natural regeneration, such as broadcast burning followed by planting to prescribed densities, may have potential to control advance regeneration (Ruth and Harris 1979).

## Thinning

Precommercial thinning, or stocking control, is the dominant treatment applied to second-growth stands under Timber Stand Improvement programs of the Alaska Region. The timber management objective of precommercial thinning is to reduce competition within the stand and concentrate growth on fewer, more vigorous trees. Currently in Southeast Alaska, precommercial thinning is concentrated on stands 12-15 years old. A shift to younger stands is expected as timber management intensifies (Ruth and Harris 1979).

A spacing of 12 by 12 ft is the most common prescription, although wider spacings may be prescribed where other objectives, such as wildlife habitat, are emphasized. Ideally, the spacing used will produce trees that are large enough for commercial thinning or clearcut harvest by the time the tree crowns become crowded once again.

Commercial thinning is conducted in stands that have reached merchantable size. Thinning is done to reduce competition, concentrate growth on fewer trees, and utilize trees that would be lost to natural mortality before the end of the rotation. Thus far in Southeast Alaska, thinning in commercial age (40-70 yr) stands has been done only on an experimental basis. Few stands of this age are now available for treatment, and markets have not developed for small material. Commercial thinning may be feasible in several decades, when extensive acreages of second growth are ready for harvest.

A program of precommercial and commercial thinning may have potential to improve habitat conditions that occur in unmanaged second growth stands in Southeast Alaska. For wildlife habitat objectives, the desired effect of precommercial thinning is to delay crown closure and prolong the existence of understory vegetation. The intensity of precommercial thinning should be such that the understory is maintained through to commercial thinning. Wide spacings (16 by 16 ft or wider) may be prescribed where wildlife objectives are emphasized. Commercial thinning would be prescribed to maintain understory vegetation through the rotation.

Alaback and Tappeiner (1984) have measured the response of understory vegetation to experimental thinnings in commercial-age stands. Responses are highly variable, and thinning has little effect on the vertical distribution of understory foliage. Accumulation of understory biomass is less than that measured in old-growth stands. These experiments were carried out in stands that had not received prior

stocking control. A coordinated program of precommercial and commercial thinning may offer more potential to manage for a stand structure that is desirable for wildlife objectives.

## Snag Management

Snag management guidelines for Southeast Alaska forests address densities, distributions, sizes, condition classes, and species of snags for management of cavity-nesting species (Rice, 1982). The means to provide these snags must be incorporated within the harvest methods and silvicultural systems that are applied to Southeast Alaska lands. Two considerations must be addressed: (1) retention of snags during the harvest operation; and (2) recruitment to replace snags that are lost by attrition during the rotation.

Clearcutting as practiced in Southeast Alaska is not compatible with snag management. Yarding by high lead cable is considered hazardous when snags are left standing within the cutting unit. All live trees are therefore removed during the harvest operation. Even if snags are left at the recommended levels, there will be no recruitment to replace snags that fall or become too highly decomposed for use by birds until trees within the regenerated stand grow to suitable size, die, and begin to decay.

Snag management is possible under the seed tree and shelterwood systems. A portion of the trees left to serve silvicultural functions may be killed and left in place to provide snags for wildlife. Snags would be recruited from remaining trees through natural or induced mortality to maintain desired snag densities. The selection system is ideal for snag management because it perpetuates an uneven-age stand that may include prescribed numbers and distributions of snags and recruitment trees.

It is unlikely that alternative silvicultural systems will replace clearcutting as the dominant system in Southeast Alaska. However, alternative systems may be applied to selected areas where cavity nesters are a featured use. Cavity nesters appear to occur at low densities over the forest in general, and at high densities in special situations such as riparian zones. A possible management strategy is to concentrate snag management in these important habitats rather than over the forest at large. These areas could be managed under alternative silvicultural systems capable of meeting snag management guidelines over time.

## Design and Scheduling of Harvest Entries

In the managed forest, the mosaic of habitats that occurs at any point in time is a product of (1) the proportions of area in the different successional stages, (2) the sizes and shapes of the harvest units, and (3) the patterns of distribution of the units over the forest. The mosaic is in a constant state of change through natural and induced successional processes and management activities.

Because the National Forest Management Act requires planning to maintain a diversity of plant and animal communities over the Forest, managers must consider the temporal as well as spatial distributions of habitat that result from management actions. Management for diversity of bird communities must provide for the needs of both edge and area-sensitive species. These two groups may be expected to respond differently to manipulation of the habitat mosaic through design and scheduling of harvest entries.

Birds of edge habitats or that utilize more than one successional stage may benefit from practices that increase edge and provide an interspersion of successional stages over the forest. The amount of edge that results from clearcutting is a function of the number of cutting units, their sizes, and their shapes. More edge is provided if the cut is spread over many small units than if it is concentrated in fewer large clearcuts. Irregular shapes provide more edge per unit area than do simple geometric shapes.

Edge that occurs at cutting unit boundaries is most pronounced where adjoining stands are dissimilar in their successional status. This effect may be achieved by scheduling entries to disperse stands that are similar in their successional development. Harris (1984) suggests that maximum age difference between adjacent stands may be maintained through successive cutting cycles if clearcuts are always positioned next to mid-rotation stands. By this reasoning, edge effect should be most pronounced under a 100-year rotation if new clearcuts are placed next to stands approximately 50 years of age.

An opposing strategy that minimizes forest fragmentation is recommended for area sensitive birds that require mature or old growth forest (Harris 1984, Robbins 1979). These recommendations, applied in Southest Alaska, would concentrate the harvest spatially to leave large blocks of old growth intact. Harvest entries would be scheduled to produce clusters of stands in a similar successional stage, rather than an interspersion of stands in different stages of development. Where blocks of old growth are retained, long rotations may be applied to surrounding stands to

provide protection (e.g., from windthrow) and to increase the effective size of the old growth habitat unit (Harris 1984). Maintenance of mature or old growth tracts within the mosaic would facilitate movement of birds among blocks of old growth (Robbins 1979).

The National Forest Management Act requires planning to produce sustained yield of wildlife species over time. Once managers have an understanding of bird habitat requirements and the effects of management, they must be able to make projections of the habitat mosaic over time and under alternative management regimes. These capabilities are provided by vegetation models, such as DYNAST (Boyce 1980), that simulate vegetation responses and successional processes to provide projections of the habitat mosaic under specified management scenarios.

The habitat requirements of all bird species must be accommodated if gamma diversity is to be maintained throughout Forest Service lands of Southeast Alaska. Edge species tend to include the more common, generalist species that may respond favorably to fragmentation of the old growth forest. Area sensitive species, cavity nesters, and other specialists are more likely to be negatively affected by forest management activities that reduce the availability of suitable habitat. In Southeast Alaska, management for forest birds will likely emphasize the latter group, and will require a better understanding of the relationships of bird species to old growth habitats.

**Appendix A.** Common and scientific names of birds that occur in forest habitats of Southeast Alaska. (Source: American Ornithologists' Union, 1983, Check-list of North American Birds, 6th edition).

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| Vancouver canada goose | *Branta canadensis fulva* |
| Green-winged teal | *Anas crecca* |
| Mallard | *Anas platyrhynchos* |
| American wigeon | *Anas americana* |
| Harlequin duck | *Histrionicus histrionicus* |
| Common goldeneye | *Buccephala clangula* |
| Barrow's goldeneye | *Buccephala islandica* |
| Bufflehead | *Buccephala albeola* |
| Common merganser | *Mergus merganser* |
| Red-breasted merganser | *Mergus serrator* |
| Osprey | *Pandion haliaetus* |
| Bald eagle | *Haliaeetus leucocephalus* |
| Northern harrier | *Circus cyaneus* |
| Sharp-shinned hawk | *Accipiter striatus* |
| Northern goshawk | *Accipiter gentilis* |
| Swainson's hawk | *Buteo swainsoni* |
| Red-tailed hawk | *Buteo jamaicensis* |
| Rough-legged hawk | *Buteo lagopus* |
| Golden eagle | *Aquila chrysaetos* |
| Merlin | *Falco columbarius* |
| American peregrine falcon | *Falco peregrinus* |
| Peale's peregrine falcon | *Falco peregrinus pealei* |
| Gyrfalcon | *Falco rusticolus* |
| Spruce grouse | *Dendragapus canadensis* |
| Blue grouse | *Dendragapus obscurus* |
| Willow ptarmigan | *Lagopus lagopus* |
| Rock ptarmigan | *Lagopus mutus* |
| White-tailed ptarmigan | *Lagopus leucurus* |
| Ruffed grouse | *Bonasa umbellus* |
| Greater yellowlegs | *Tringa melanoleuca* |
| Spotted sandpiper | *Actitus macularia* |
| Bonaparte's gull | *Larus philadelphia* |
| Ancient murrelet | *Synthliboramphus antiguus* |
| Band-tailed pigeon | *Columba fasciata* |
| Mourning dove | *Zenaida macroura* |
| Western screech owl | *Otus kennicottii* |
| Great horned owl | *Bubo virginianus* |
| Northern hawk-owl | *Surnia ulula* |
| Northern pygmy owl | *Glaucidium gnoma* |
| Great grey owl | *Strix nebulosa* |
| Short-eared owl | *Asio flammeus* |
| Boreal owl | *Aegolius funereus* |
| Northern saw-whet owl | *Aegolius acadicus* |
| Vaux's swift | *Chaetura vauxi* |
| Rufous hummingbird | *Selasporus rufus* |
| Belted kingfisher | *Ceryle alcyon* |
| Red-breasted sapsucker | *Sphyrapicus ruber* |
| Downy woodpecker | *Picoides pubescens* |
| Hairy woodpecker | *Picoides villosus* |
| Three-toed woodpecker | *Picoides tridactylus* |
| Black-backed woodpecker | *Picoides arcticus* |
| Northern flicker | *Colaptes auratus* |
| Olive-sided flycatcher | *Contopus borealis* |
| Western wood-pewee | *Contopus sordidulus* |
| Alder flycatcher | *Empidonax alnorum* |
| Hammond's flycatcher | *Empidonax hammondii* |
| Western flycatcher | *Empidonax difficilis* |
| Say's phoebe | *Sayornis saya* |
| Tree swallow | *Tachycineta bicolor* |
| Violet-green swallow | *Tachycineta thalassina* |
| Northern rough-winged swallow | Stelgidopteryx serripennis |
| Bank swallow | *Riparia riparia* |
| Barn swallow | *Hirundo rustica* |
| Gray jay | *Perisoreus canadensis* |
| Steller's jay | *Cyanocitta stelleri* |
| Black-billed magpie | *Pica pica* |
| Northwestern crow | *Corvus caurinus* |
| Common raven | *Corvus corax* |
| Black-capped chickadee | *Parus atricapillus* |
| Boreal chickadee | *Parus hudsonicus* |
| Chestnut-backed chickadee | *Parus rufescens* |
| Red-breasted nuthatch | *Sitta canadensis* |
| Brown creeper | *Certhia americana* |
| Winter wren | *Troglodytes troglodytes* |
| American dipper | *Cinclus mexicanus* |
| Golden-crowned kinglet | *Regulus satrapa* |
| Ruby-crowned kinglet | *Regulus calendula* |
| Mountain bluebird | *Sialia currucoides* |
| Townsend's solitaire | *Myadestes townsendi* |
| Gray-cheeked thrush | *Catharus minimus* |
| Swainson's thrush | *Catharus ustulata* |
| Hermit thrush | *Catharus guttata* |
| American robin | *Turdus migratorius* |
| Varied thrush | *Ixoreus naevius* |
| Bohemian waxwing | *Bombycilla garrulus* |
| Cedar waxwing | *Bombycilla cedrorum* |
| Northern shrike | *Lanius excubitor* |
| Orange-crowned warbler | *Vermivora celata* |
| Yellow warbler | *Dendroica petechia* |
| Yellow-rumped warbler | *Dendroica coronata* |
| Townsend's warbler | *Dendroica townsendi* |
| Blackpoll warbler | *Dendroica striata* |
| Northern waterthrush | *Seiurus noveboracensis* |
| MacGillivray's warbler | *Oporornis tolmiei* |
| Wilson's warbler | *Wilsonia pusilla* |
| Western tanager | *Piranga ludoviciana* |
| Brewer's blackbird | *Euphagus cyanocephalus* |
| Common grackle | *Quiscalus quiscula* |
| Rosy finch | *Leucostice arctoa* |
| American tree sparrow | *Fringilla arborea* |
| Chipping sparrow | *Spizella passerina* |
| Fox sparrow | *Passerella iliaca* |
| Song sparrow | *Melospiza melodia* |
| Lincoln's sparrow | *Melospiza lincolnii* |
| White-throated sparrow | *Zonotrichia albicollis* |
| Golden-crowned sparrow | *Zonotrichia atricapilla* |
| White-crowned sparrow | *Zonotrichia leucophrys* |
| Harris' sparrow | *Zonotrichia querula* |
| Dark-eyed junco | *Junco hyemalis* |
| Pine grosbeak | *Pinicola enucleator* |
| Purple finch | *Carpodacus purpureus* |
| Red crossbill | *Loxia curvirostra* |
| White-winged crossbill | *Loxia leucoptera* |
| Common redpoll | *Carduelis flammea* |
| Pine siskin | *Carduelis pinus* |
| Evening grosbeak | *Coccothraustes vespertinus* |

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